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THE TELEGRAPHIC JOURNAL

AND

ELECTRICAL REVIEW.

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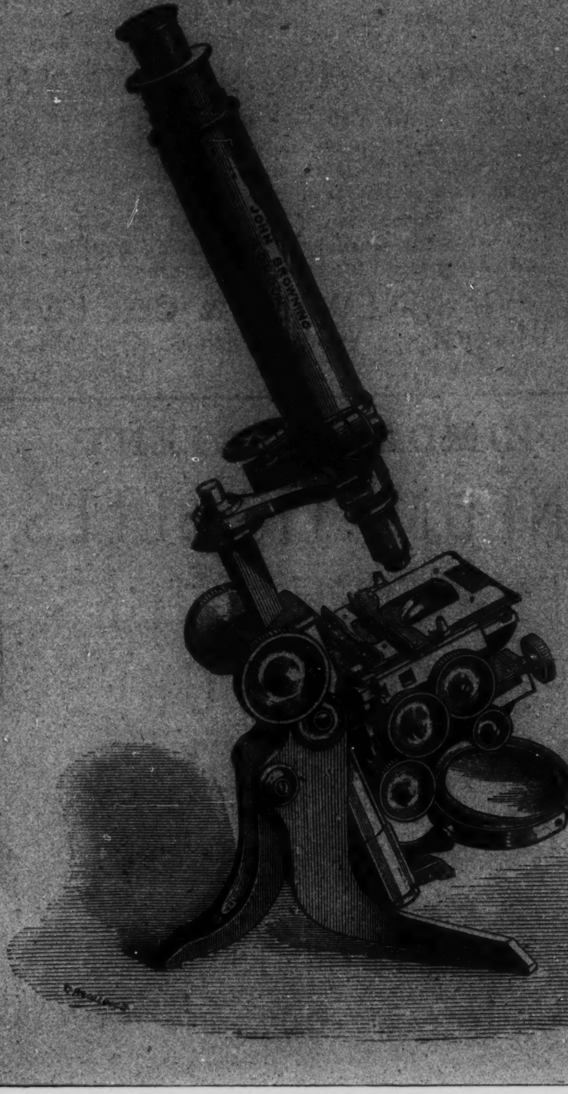

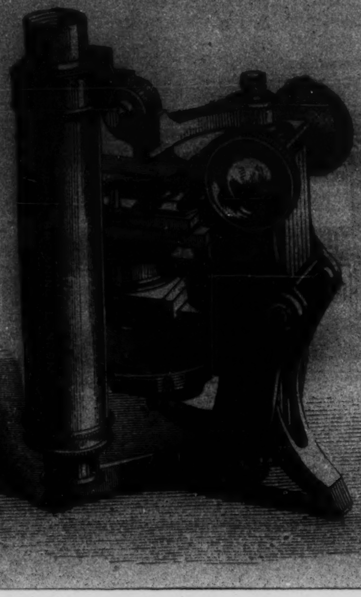

THE

TELEGRAPHIC JOURNAL

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VOL. IV. SEPTEMBER 1, 1876. No. LXXXVI.

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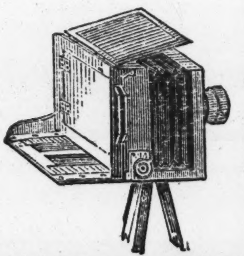

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THE TELEGRAPHIC JOURNAL.
VOL. IV.—No. 86.

ON FACILITIES OFFERED TO THE PUBLIC IN TELEGRAPHING.

THAT within the short period since the telegraphs were taken over by the State (1870), the annual number of messages sent should have increased from six millions to twenty millions, is a fact pregnant with meaning. While the progress of a great social reform (like that inaugurated by the telegraph), and the public appreciation of the fact that distance need now form no obstacle to prompt inter-communication, may appear to some too slow and gradual, none can fail to recognise in what numberless ways such a development as that just indicated must have promoted the comfort, enterprise, and wealth of the nation. To what extent these advantages are counterbalanced by the exchange of a leisurely existence—the olden times of stage coaches, and of letters costly and few—for that life at high pressure which, to some, means shortened life, we must leave to the moralist to determine.

It is matter for regret that the accounts of the Telegraph Department, as presented to Parliament, convey but a very imperfect impression of the true position of the undertaking. Indeed, five years of State Telegraphs is probably too short to allow of our estimating their permanent financial position. It appears that the present increase of the revenue is about 10 per cent. per annum, though one cannot say how long this may continue. While the revenue has gone on increasing these five years, at the rate of 7, 30, 8, 6, and 11 per cent. successively, the expenditure has increased, till lately, at a greater ratio, the corresponding numbers for working expenses being 50, 47, 10, and 11 per cent. increase, but (in 1875-6) 4 per cent. decrease. The possibility of decreasing the working expenses calls for careful consideration, and the evidence recently furnished to the Select Committee on the Telegraph Department indicates various directions in which this decrease may be effected.

When the State assumes direction and control of the Telegraph system in a country, the object aimed at should evidently be (as was stated in preamble of the Act) to afford "a cheaper, more widely extended, and more expeditious system of telegraphy" to the public; and all proposals for increasing the revenue from telegraphs should be tested by this criterion. The Committee just named had occasion to weigh a number of such proposals, and have communicated their views concerning these in their recently published Report. We may briefly notice some of the suggestions made.

The recommendation by the Treasury Committee, last year, of a tariff at a penny per word, which would raise an ordinary shilling telegram (of twenty-nine words, addresses included) to 2s. 5d., was thought contrary to the purposes of the Act; though there would be compensating advantages in the public being allowed to send messages under a shilling.

The public, it is found, are apt to extend the titles and addresses of the sender and the receiver of a telegram to undue length. It has been proposed to charge for the addresses. The old restriction, however, on addresses, was found often, in the case of the receiver's address, to involve much trouble in delivery. This objection does not apply to the sender, and the Committee think an economy might be realised by taking the address of the sender merely for reference, and not to be transmitted unless it were paid for as part of the telegram.

In Melbourne a considerable saving of labour and stationery has been effected by sending out messages without envelopes—merely closed and gummed and addressed on the back.

It was suggested by the Glasgow Postmaster that short messages of twelve words, including addresses, should be sent for 6d. (this was expected to largely increase local traffic), and Major Webber proposed that a class of deferred messages should be instituted, for which there should be a charge of 6d. for ten words in the body of the message, and 3d. for every additional ten words. Over these second-class messages, the ordinary 1s. messages would have the priority; but in any case the delay could not be great. The advantages offered are, that in small localities telegrams would be largely multiplied; and that wires which now remain comparatively idle a great part of the day would have fuller and more evenly distributed work. The further proposal to charge an augumented rate for express messages the Committee regard with less favour than the two preceding; but, as they remark, all suggestions of the kind depend on the capacity of the Post Office to transmit many more messages than is now done. In the present condition of telegraph revenue they do not think it advisable to recommend a general 6d. rate for short messages or for local traffic. In large towns pneumatic tubes might be more freely used to lessen the pressure on the wires. A large increase in the capacity of the wires and instruments to transmit more messages than at present is hopefully anticipated.

The proposal that an increased charge of 6d. should be made on messages handed in between 8 p.m. and 8 a.m., and on those sent on Sundays, was disapproved of, as also that of an increased charge of 3d. on messages handed in at offices of railway stations. In the former case, the offices at which such messages are received are those which must in any case be kept open. On the other hand, the offices of railway stations are decreasing in number, and the charge of 3d. for railway agency is therefore becoming a less important item in the accounts.

A proposal of the Postmaster-General to increase the rates for transmitting news the Committee consider of more importance. At present the charges are 1s. for seventy-five words of news messages sent during the day, and for one hundred words during the night, and 2d. for each copy of the same message wherever it may be sent. The proposal is to charge 1s. for seventy-five or one hundred words for each separate town to which each mesaage may be sent, and to limit the 2d. copy rate to copies delivered by hand in the same town. An increase of £30,000 in the revenue is estimated to accrue from this, if a large reduction of work should result from the change.

It did not clearly appear what amount of loss was sustained by the Post Office through the transmission of news from news associations, and the exceptionally favourable terms afforded to news as compared with commercial messages; but as soon as the amount should be clearly ascertained, the copy rate should (in the opinion of the Committee) be increased so as to cover any deficiency in the service. This plan appeared preferable, and more equitable than that suggested of charging full rates for each separate transmission; while it is but right that the public should not incur loss in the transaction of newspaper work.

An abuse seems to have crept in by way of the present system of counting. The Act says these news messages are to be transmitted "at the rate of" 1s. for seventy-five words by day or one hundred by night to one address, and 2d. extra for each additional address. Hitherto all the words in a particular service have been connected together, and charged at the rate specified. Now with a certain class of news it happens that many really separate messages, which require to be sent and delivered separately, are included in a single seventy-five or one hundred words, and are charged for as if they involved only one transmission, one set of addresses, and one delivery. In one instance the Post Office was called on to deliver 1640 messages for £1 15s. 2d., or one farthing each. This was never intended or anticipated, and is no wise justified by the analogy of ordinary commercial messages; the Committee therefore recommend that a fixed minimum charge of 1s. for one address, and 2d. for every additional address, might fairly be made for every message requiring separate transmission and delivery. They recommend, also, that (following the analogy of commercial messages) an extra 3d. should be charged for every eighteen or twenty-five words to a single address, by day or by night respectively, and an extra halfpenny for its transmission to every additional address. This is better than the proposal of the Post Office that each message handed in, whatever its length, should be charged separately.

It is clear that all increase of traffic which can be brought about without loss to the revenue adds to the national value of the system; and we may fully endorse the opinion of the Committee, that the true method of making the Telegraph Department remunerative is to be sought not in the direction of curtailment of the facilities at present offered to the public, or of increase of charges, but in that of increase of facilities, and at the proper time, diminished charges.

ON SOME IMPROVEMENTS IN QUADRUPLEX WORKING, SOME OF THEM BEING APPLICABLE TO OTHER PURPOSES.

BY G. K. WINTER, TELEGRAPH ENGINEER, MADRAS RAILWAY.

SINCE my papers on Quadruplex Telegraphy were written, I have made two or three improvements that have added a good deal to the efficiency of the arrangements; and as some of them are applicable to other purposes, they may be interesting to your readers.

When the bridge is applied to the double sending arrangements, so as to convert it into a quadruplex system, I find, as I stated in my pamphlet, that the adjustment becomes more difficult; and this is especially so when working on long lines. The reason of this is that the bridge forms a short circuit for the extra currents generated in the electro-magnets of the relays. This I at first remedied by an electro-magnetic shunt, as I have already stated. Additional battery power is, however, necessitated by this plan, and that is not desirable; I have, therefore, sought to remedy the evil by converting the bridge itself into an electro-magnetic shunt. The two branches are wound differentially on the iron core, which is made movable, so that the amount of compensation can be adjusted. This arrangement not only prevents the bridge forming a shunt for the extra currents, but also, if sufficient power, is able to counteract the retardation of received signals caused by electro-static capacity of the line. It is, I believe, this shunting action of the duplex bridge, when formed of simple resistance, which renders the bridge method generally inferior to the differential method of duplex working, especially when applied to high speed instruments. There are, however, some instruments and methods in which the differential duplex system cannot be used, or to which the bridge system is the more easily applied; in these methods I have no doubt that the electro-magnetic bridge will be found very useful.

Some time ago, Mr. Culley pointed out that on the Dublin and London circuit the speed was greater between Dublin and London than *vice versâ*. It seems to me that this is easily explained by the fact that the electro-static capacity of the cable acts as a shunt to the self-induced currents of the receiver at Dublin, and hence causes an increase of the magnetic retardation; whereas the resistance of the long land line between Holyhead and London diminishes to a great extent the effect of this action. The difference in speed should be very much less if a chemical receiver were used instead of the Wheatstone receiver, as in that case extra currents would not be formed.

The next improvement is in the arrangement of the keys and battery. Instead of the series of powers—

1st.	Both keys at rest	+ 2
2nd.	A depressed, B at rest...	+ 1
3rd.	Both keys depressed......	0
4th.	B depressed, A at rest ...	— 1

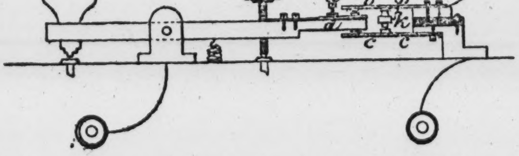
I now use—

1st.	Both keys at rest	+ 3
2nd.	A depressed, B at rest...	+ 1
3rd.	Both keys depressed......	— 1
4th.	B depressed, A at rest ...	— 3

which I find more economical and quite as good.

The arrangement of the keys is exactly the reverse of the American arrangement. When both keys are at rest we have three units of plus current; when key A is depressed, this is reduced to one. When key B is depressed, it simply reverses the current converting + 3 into — 3 or + 1 into — 1, as the case may be.

The reversing key, which I think is new, is shown in the following figure which will be readily understood.



It is very important that there should be the smallest possible interval between the direct and inversed positions of the key; the adjustment for this is made by the screw *a*.

The two springs *b b* and *c c* are separated from each other by a sheet of ebonite, and are connected respectively with line and earth. The lever *d* and the bridge *k* are connected respectively with the copper and zinc ends of the battery. In a position of rest, as shown in the figure, the lever *d* is in contact with the spring *c*, while the spring *b* is in contact with the bridge *k*. When the key is depressed, the spring *c* comes in contact with the bridge, while the lever makes contact with the spring *b* and at the same time breaks its contact with the bridge *k*. This key may have as small a play as you please.

ELECTRIC LIGHTING IN FRANCE.

According to the *Moniteur Industriel Belge*, the method of lighting railway termini, workshops, &c., with electric light from Gramme machines (on M. Lambotte's system) is coming rapidly into favour in France. M. Lambotte made trial of various motors, and at last had recourse to a small compressed-air engine of two-horse power, having a pully one metre in diameter and a very heavy fly-wheel. This works regularly; but as with all motors, when the exterior circuit was broken (by rupture of wires and consumption of carbon points) the magnetism ceased and the motor raced. M. Lambotte remedies this by means of a hammer acting automatically. In the use of a dynamo-electric machine, the exterior circuit has to be arranged with great precision. Should this be too resistant, more motor force is necessary to obtain the maximum of light, and, besides, the circuit is *heated*. If it be not resistant enough, less force is needed; but then the Gramme machine is itself heated, sometimes so much that one cannot hold the hand on it. M. Lambotte inserts in the circuit a galvanometer and a thermometer. The former is an ordinary instrument, with a long aluminium needle. The motor and the Gramme machine being constant in speed, the needle maintains the same deflection. Should there be variations in speed, the galvanometer indicates them at once; it indicates, too, if the circuit be broken; or if there be contact of the two wires going to the lamp (the resistance then being diminished). It has happened, with the Gramme, that the engine moving with ordinary speed, and the galvanometer showing the usual deflection, yet no light is got. There must then be a fault in the circuit; and it is probably found in the moving ring, or the bobbins touch the central piece of soft iron. The galvanometer, placed near the engine-man, is a c apparatus of the nature of a manome thermometer has the same object. With a current, the maximum of heat is fixed. much current pass, the thermometer indicates immediately. It is a simple electro-magnet, in the interior of which is placed an ordinary thermometer. Lighting, by means of the Gramme machine, has lately been adopted by the Compagnie Du Nord, for the platform of the station of La Chapelle, and the Paris-Lyons-Mediterranean Company are also adopting it in some of their stations.

VOLTAIC ELECTRICITY.

BY PROFESSOR TYNDALL, D.C.L., LL.D., F.R.S.

LECTURE VI.

ON the 18th of March, 1813, Sir Humphry Davy submitted to the managers of the Royal Institution the following recommendation:—"Sir Humphry Davy has the honour to inform the managers that he has found a person who is desirous to occupy the situation in the Institution lately filled by William Payne. His name is Michael Faraday. He is a youth of twenty-two years of age. As far as Sir H. Davy has been able to observe or ascertain, he appears well fitted for the situation. His habits seem good; his disposition active and cheerful, and his manner intelligent." It was therefore resolved "That Michael Faraday be engaged to fill the situation lately occupied by Mr. Payne on the same terms."

For the first seven years of his engagement Faraday assisted Davy. His first contribution to science was an analysis of caustic lime from Tuscany. In 1818 he experimented on "Sounding Flames." In 1820 a paper on two new compounds of chlorine and carbon was honoured with a place in the Philosophical Transactions. The discoveries of Oersted and Ampère of electro-magnetic phenomena in 1820 occupied the thoughts of all scientific men. Faraday read much about it, and in 1821 he wrote a history of the progress of electro-magnetism, which he published in "Thomson's Annals of Philosophy." Soon afterwards he took up the subject of "magnetic rotations," and on the morning of Christmas-day, 1821, he called his wife to witness for the first time the revolution of a magnetic needle round an electric current. For the next ten years his time was spent as follows:—Liquefaction of Chlorine, 1823; Discovery of Benzole, 1825-6; On Glass for Optical Purposes, 1829; Optical Deceptions, Chromatrope, &c., 1831; Vibrating Surfaces, 1831.

And here he really entered upon his great career. The progeny of Voltaic Electricity is to occupy us for the next two lectures.

Faraday knew that under ordinary circumstances the presence of an electrified body was sufficient to excite, by induction, an unelectrified body. He knew that the wire which carried an electric current was an electrified body, and still all attempts had failed to make it excite in other wires a state similar to its own. He began his experiments on the induction of electric currents by composing a helix of two insulated wires, which were wound side by side round the same wooden cylinder. One of these wires he connected with a voltaic battery of ten cells, and the other with a sensitive galvanometer.* When connection with the battery was made, and while the current flowed, no effect whatever was observed at the galvanometer. He raised his battery from ten cells to 120 cells, but without avail. The current flowed calmly through to the battery wire without producing, during its flow, any result upon the galvanometer. He, however, noticed that a feeble movement of the needle always occurred at the moment when he made contact with the battery; that the needle would afterwards return to its former position and remain quietly there, unaffected by the flowing current. At the moment the circuit was interrupted the needle again moved, but in a direction opposed to that observed on the completion of the circuit. This result and others led him to conclude that the battery current through the one wire did in reality induce a similar current through the other, but that it continued for an instant only, and partook more of the nature of the electric wave from a Leyden jar than of the current from a voltaic battery.

The mere approach of a wire forming a close curve to a second wire through which a voltaic current flowed was next shown by Faraday to be sufficient to arouse in the neutral wire an induced current, opposed in direction to the inducing current; the withdrawal of the wire also generated a current having the same direction as the inducing current. For the following experiments, two flat spirals, each formed of covered copper wire, were used. One of the spirals was laid flat on a table, its two ends being connected with a galvanometer; the other spiral is connected with a voltaic battery, with which the connection can be established or broken at pleasure. Laying one spiral upon the other, or sending a current through the inducing spiral, the needle of the galvanometer is suddenly driven aside by the current induced in the other spiral, but the force passes away in an instant, and the needle returns to its first position. On interrupting the current the needle also receives a shock, being deflected in the opposite direction. Holding the secondary spiral at a distance from the primary, a current is aroused on causing the secondary spiral to approach the primary; this current ceases the moment the motion ceases. On *withdrawing* the secondary spiral from the primary, a current is also aroused; this current also ceases the moment the motion of withdrawal ceases.

Magnetism has been produced from electricity, and Faraday now attempted to effect the evolution of electricity from magnetism. Round a welded iron ring he placed two distinct coils of covered wire, causing the coils to occupy opposite halves of the ring. Connecting the ends of one of the coils with a galvanometer, he found that the moment the ring was magnetised by sending a current through *the other coil*, the galvanometer needle whirled round four or five times in succession; the action, as before, was that of a pulse which vanished immediately. On interrupting the circuit, the needle whirled in the opposite direction.

The effects obtained with the welded ring were also obtained with straight bars of iron. Permanent steel magnets were then substituted for the iron bars, and the same effects were obtained by merely thrusting such a bar-magnet into a coil of wire. A rush of electricity through the coil accompanied the insertion of the magnet; an equal rush in the opposite direction accompanied its withdrawal.

Here at once the solution of Arago's enigma fell into his hands. Faraday saw mentally

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* Dr. Tyndall, whilst speaking, performed all the experiments he described, and in the same manner.

Arago's rotating disc of copper under the operation of the magnet flooded with his induced currents, and showed by actual experiments that when the disc rotated currents passed through it, their position and direction being such as must, in accordance with the established laws of electro-magnetic action, produce the observed rotation of the magnet suspended above it.

Before we proceed further, we must make ourselves acquainted with a conception which was a guiding light to Faraday in all these researches. When iron filings are scattered over a magnet, the particles of iron arrange themselves in certain determinate lines called magnetic curves. In 1831, Faraday for the first time called these curves "lines of magnetic force," and he showed that to produce currents neither approach to, nor withdrawal from, a magnetic source, or centre, or pole, was essential, but that it was only necessary to cut appropriately the "lines of magnetic force." Dropping a flat coil, connected by its two ends with a galvanometer, between coincident poles of two magnets, produces no action; but letting it fall between opposite poles produces a prompt action.

When a conductor moves *along* the lines of force, no induced currents appear; but when it moves *across* the lines of force, such currents are generated. Faraday proved, for example, that when a metal disc is caused to rotate so as to be tangent to the lines of force, no current appears; while, when the disc in its rotation *cuts* the lines of force, currents flow along the disc, from the the centre to the circumference, and from the circumference to the centre.

Faraday showed that the lines of force of terrestrial magnetism suffice to produce induced currents when they are intersected. In fact, all the effects of magneto-electric induction may be obtained from the magnetism of the earth.

When a conductor rotates round an axis which is parallel to the lines of force, it experiences simply the resistance due to the friction of the air; but if the axis of rotation be transverse to the lines of force, the rotation is retarded by the interaction of the magnet and the induced currents.

This retardation may become so powerful as to arrest the rotation. If, for example, a cube or sphere of copper, suspended from a twisted string, be caused to spin, by untwisting, between the poles of an unexcited electro-magnet, it experiences the retardation due to air-friction only; but on the supervention of the magnetic force, the rotation is suddenly arrested. Faraday showed that in passing a plate of copper rapidly to and fro between the magnetic poles you seem to be cutting cheese, though nothing is visible. It is as if pure space were a kind of solid.

If by mechanical means the conductor be compelled to rotate, or to move to and fro between excited poles, it will be heated; the heat may be rendered sufficiently intense to melt fusible metal. Between unexcited poles no effect of this kind is produced.

The repulsion set up by induced currents between the helices and the moving masses of iron in an electro-magnetic engine would of itself limit the practical application of electricity as a motive power. Nevertheless, though such engines speedily reach the limit of their action, the conversion of molecular force into mechanical effect may be rendered far more perfect than in the case of the steam-engine.

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ON THE PROOF OF A FORMULA GIVEN BY MR. KEMPE

In the *Telegraphic Journal* of April 1st, 1876.

BY C. HOCKIN, M.A.

(Concluded from page 222.)

THE observations are therefore four in number:—

First, the "constant of the instrument" is taken for a permanent deflection and for a throw also 1

Second, the deflection when the large battery is flowing into the cable is observed 2

Thirdly, the deflection d due to the instantaneous discharge 3

Fourth, the deflection d_1 due to the earth current and observed as soon as possible after the discharge 4

From 1_4 and 2, f, the resistance of the cable and fault is calculated.

From 2 and 4, n, the ratio of the electro-motive force of the battery to that at the fault, is calculated.

From 3 and 4 D is found, and thence ρ by comparison with a condenser of known capacity, and, finally, z is known when f, n, and ρ have been determined.

It is here assumed that the discharge of the cable takes place in a time short compared with the whole time occupied by a swing of the needle from zero to rest at the turning point or the whole time occupied by the throw.

Let π as usual represent 3·1416. . . . , and let l be length of cable and ϵ the base of natural logarithms. Then, the proportion that the charge left in the cable t seconds after commencement of discharge bears to the whole charge taken by the cable, is expressed, when the resistance at the broken end is indefinitely great, by the formula—

$$\frac{8}{\pi^2}\left(\epsilon^{-\frac{\pi^2}{4\,k\,c\,l^2}t} + \frac{1}{9}\epsilon^{-\frac{9\pi^2}{4\,k\,c\,l^2}t} + \frac{1}{25}\epsilon^{-\frac{25\pi^2}{4\,\kappa\,c\,l^2}t} + \&c.\right) \cdot \text{IX}$$

and when the resistance at the end is indefinitely small by the formula—

$$\frac{6}{\pi^2}\left(\epsilon^{-\frac{\pi^2}{k\,c\,l^2}t} + \frac{1}{4}\epsilon^{-\frac{4\,\pi^2}{k\,c\,l^2}t} + \frac{1}{9}\epsilon^{-\frac{9\,\pi^2}{k\,c\,l^2}t} + \&c.\right) \cdot \text{X}$$

and the time that elapses in the two cases before the discharge is complete within 1%, 0·9% &c., is given below for the two cases—

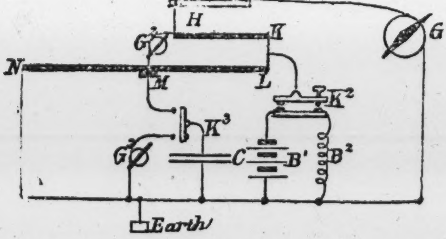
Percentage of charge left in cable.	*Time occupied in partial discharge in terms of $k\,c\,l^2$.*	
	Fault of infinite resistance.	*Fault of no resistance.*
	A	B
1·0	0·336	0·0785
0·9	0·343	0·0803
0·7	0·353	0·0828
0·8	0·363	0·0853
0·6	0·375	0·0883
0·5	0·389	0·0917
0·4	0·406	0·0960
0·3	0·428	0·1015
0·2	0·457	0·1092
0·1	0·512	0·1225

The cable discharges itself therefore rather more than four times as fast when the fault has no resistance as it does when the fault has an infinite resistance.

To ascertain the proper rate of vibration for the galvanometer needle an approximate determination of the distance of the break must first be made with any convenient adjustment of the galvanometer. Then the time of oscillation of the needle must be roughly determined, and $k\,c\,l^2$ calculated (or the total capacity of the cable in *microfarads* multiplied by its total resistance in *megohms*). The last result multiplied by the numbers in the last two columns of the table given above will give the time in seconds requisite for the cable to discharge itself to the degree of accuracy required in practice, and the galvanometer needles must be weighted or rendered more or less astatic until the time occupied by a single throw of the needle exceeds the product found from column A_2.

In practice it may be convenient to use two instruments—one to determine the resistance of the fault immediately before the discharge, and another to read the discharge. The last instrument must be furnished with needles that vibrate very freely, suspended by a fibre with as little viscosity as may be and little affected by the resistance of the air.

A convenient arrangement of the test may be as follows:—



K_1 is a key well insulated, the moving bar strong and rigid, adjusted so that the play may not exceed 2 or 3 thousandths of an inch. G_1, connected with the back contact of the key, is the galvanometer with freely-swinging needle. G_2 a Thomson's reflecting galvanometer, with, preferably, a dead beat mirror. G_3 a third galvanometer, best a Thomson's reflecting galvanometer, the motion of the mirror being damped only in the usual manner by a fan.

B_1 is the testing battery, B_2 a resistance equal to that of B_1, H K is any convenient resistance, L M, M N adjustable resistances—preferably L M N may be a Varley's "slide resistance"—C is a condenser of known capacity.

The key K_3 allows the condenser C to be charged at the point M and then discharged through G_3, K_2 allows either B_1 or B_2 to be connected with the junction of the coils H K and L M.

The observations are made in the following manner:—

Set M in the middle of the resistance L N, and adjust H K until no great change in the deflection on G_2 occurs when, by means of K_2, B_2 is substituted for B_1.

Let H K have resistance R.

Then adjust the position of M exactly, so that on substituting B_2 for B_1 no change takes place in the deflection of the galvanometer G_2, and at this point

Let L M $= m\,r$, M N $= (1-m)\,r$ or, let $10{,}000m$ be the "slide reading."

As quickly as possible after this reading is taken move M until there is no deflection on G_2 and the moment the position is found let one observer discharge C by means of k_3 through G_3, and let another discharge the cable through G_1 by means of k_1—reading both the first throw and also the deflection at the end of the back swing of the needle, keeping k_2 of course down during the return throw.* The key k_1 should be put down by

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* Mr. Kempe suggests a spring key for this purpose, but a strongly-made discharge key, such as the ordinary key on a Siemens' Morse instrument mounted on ebonite, will, I think, answer the purpose in many cases. The hand can certainly be brought down on the key moving at the rate of 10 feet a second, and if the play of the key is $\frac{1}{500}$th inch the time lost between the contacts is $\frac{1}{500} \times \frac{1}{120} = \frac{1}{60{,}000}$th of a second.

Take the extreme case of one knot of cable being in circuit and the resistance at the end of the cable being a small proportion of even its small resistance. Then, the proportion of charge remaining after $\frac{1}{60{,}000}$th second is not less than—

$$\frac{32}{\pi^3}\left(\epsilon^{-\frac{\pi^2}{4\,k\,c\,l^2}t} - \frac{1}{27}\epsilon^{-\frac{9\,\pi^2}{4\,k\,c\,l^2}t} + \frac{1}{125}\epsilon^{-\frac{25\,\pi^2}{4\,k\,c\,l^2}t} - \&c.\right)$$

Suppose K = 10, ohms, $c = 0{\cdot}3$ microfarads and proportion exceeds—

$$\frac{32}{\pi^3}\left(\epsilon^{-\frac{\pi^2 \times 10^6}{4 \times 3 \times 6 \times 10^4}} - \&c\right.$$

$$= \frac{32}{\pi^3}\left(\epsilon^{-\frac{9{\cdot}87}{4 \times 18}100} - \&c.\right)$$

a strong blow, so that the least possible time should elapse between the contacts, because, if the break in the cable is only a few knots distant, and the resistance at the break is not very large, a considerable proportion of the charge may escape at the break even in the thousandth of a second.

When G_2 was at zero

Suppose L M = $m'r$, M N = $(1-m')\,r$.

Let d be the deflection on G_3. D' the first deflection on G_1, and D'' the second deflection, which is to be reckoned positive when it is in the opposite direction to D', as will always be the case if the motion of the needles be sufficiently free.

Lastly, after a satisfactory series of observations have been obtained, charge C to any convenient potential, and discharge it through G_3; then recharge it to the same potential and discharge it through G_1, to determine the relative sensitiveness of the two instruments for instantaneous discharges. Call n the ratio of the sensitiveness of G_1 to that of G_3 thus determined, and calculated on the assumption that the shunts of G_1 and G_3 are for both galvanometers the same as they were when the observations were made on the cable.

In making these reductions the correction for the current induced in the galvanometers by the motion of the needle itself must be introduced. (*Vide Kempe on "Electrical Testing," p.* 123.)

Then f, the true resistance of cable and fault, is found from

$$f = \frac{1-m}{m}\,R \cdots\cdots\cdots \text{XI}$$

d, the throw on G_3, is a measure of the potential at H at the moment of discharging the cable.

Let g be the resistance of the circuit of G_1 when shunted as it was during the test of the cable.

The capacity of the condenser C is known to be equal to the capacity of a certain length of cable, suppose that length to be l knots and that the resistance of the conductor of l knots of cable is ρ.

Then the resistance of the cable up to the break (z say) is determined by—

$$\frac{1}{n}\,\frac{\sqrt{D'D''}}{d}\,\rho = \frac{1}{3}\,\frac{1+\dfrac{m'-m}{m\,(1-m')}\,\dfrac{g}{g+f}}{f\,(f+g)}\left(f^3-(f-z)^3\right) \cdot \text{XII}$$

$$\text{Or } z = f - \sqrt[3]{f^3 - \frac{1}{3}\,\frac{\sqrt{D'D''}}{d}\,\frac{\rho f\,(f+g)}{1+\dfrac{(m'-m)\,g}{m\,(1-m')\,(f+g)}}}$$

$$= f - \sqrt[3]{f^3 - \frac{1}{3}\,\frac{\sqrt{D'D''}\,.\,m\,.\,(1-m')\,.\,\rho\,.\,f\,.\,(f+g)^2}{d\,\left(m\,(1-m')\,f+m'\,(1-m)\,g\right)}} \cdot \text{XIII}$$

The first method given where all measurements are made by direct deflection may be convenient when the earth-current varies very rapidly, and a battery of small resistance which does not greatly alter in electro-motive force when it is flowing through a small resistance is at hand. If the earth-current is not altering very rapidly and sufficient apparatus is to be had, I think the second method will be found the most convenient, and will give the best results.

If a great many observations are made to determine the distance z, the most accurate way to reduce the results is either to work out z from each observation, or to form equation XII from every observation; add the equations together and then calculate z from the sum. After observing the throw on G_3 the values of m and m' should again be tested, and if they have altered sensibly a new series of observations must be taken.

If no galvanometer such as G_1 is at hand, but only an instrument in which the needle comes soon to rest after a discharge, some method of direct observation must be adopted to separate the part of the motion due to the true discharge of the cable from that due to the permanent earth-current. For example: the first throw D_1', may be read, then the return throw D'', and also D''' the next deflection in the direction of D'.

A current may then be sent through the galvanometer producing the deflection D'' permanently by any convenient arrangement.

By a key such as K_2 this may be altered quickly to an arrangement in which another permanent current passes through G_1, such that the first motion of the needle after the substitution is from D'' to D'''. Lastly, the standard condenser may be charged to such a potential that when it is discharged through G_1 with the second arrangement in circuit the three deflections $D,'$ $D,''$ D''' are all reproduced. Then the true discharge from the cable will be the same as that from the condenser. The particular method best to employ will readily suggest itself in any practical case.

* * *

The cupola of the Western Union building in Philadelphia caught fire about one o'clock on the morning of July 25th, and, together with the roof of the building, was totally destroyed. All of the wires leading from the cupola to the operating room were burnt. No delay of moment, however, occurred to the business of the Company, as the wires were soon temporarily repaired. The entire loss is estimated at about five thousand dollars; that on the building (which was insured), about three thousand dollars.

$= \epsilon - 14$ nearly, and therefore practically, the whole charge will have escaped in much less than $\frac{1}{60{,}000}$th of a second, in fact, the key must in this case be put down in the nine-millionth of a second to obtain a good result, and some special form of key would be quite essential. But if the fault is 10 miles distant, the proportion becomes—

$$\frac{32}{\pi^3}\left(\epsilon^{-0\cdot14} - \&c.\right)$$

and but little charge is lost in $\frac{1}{60{,}000}$th of a second. If a single knot of cable only is in circuit, the method will probably fail unless the resistance at the far end is very large from the great excess of the current due to earth current over that due to true discharge.

Notes.

The Congress of the French Association for the Advancement of Science was opened at the Hotel de Ville, Clermont, on the 15th of August, the president, M. Dumas, giving an address, which was general in its scope. The Association lately obtained the recognition of the Government, as being "of public utility," and appears to be at present in a flourishing condition. The funds this year amount to £7000, and the membership numbers 2200.

Among recent awards by the French *Société d'Encouragement pour l'Industrie Nationale*, medals were given to M. Hardy, for telegraphic apparatus and instruments of precision; to MM. Delachanal and Mermet, for a new spectro-electric tube; to M. de Laguerenne, for a new electric clock; to M. Camacho, for his tubular electro-magnet with several cores; and to M. Debayeux, for telegraphic apparatus for the service of hotels.

The *Telegrapher* calls to mind that Thursday, July 27th, was the tenth anniversary of the successful completion of the laying of the 1866 Atlantic cable, by means of which regular telegraphic communication was established between Europe and the United States. The cable was landed at Trinity Bay, Newfoundland, July 27th, 1866, but owing to the interruption to the cable across the Gulf of St. Lawrence, there was two days' delay in receipt of the intelligence at New York. The following is the brief announcement which made known the important fact to the public:—"Heart's Content, July 27th.—We arrived here at nine o'clock this morning. All well. Thank God, the cable is laid and is in perfect working order.—Cyrus W. Field." Although regular cable communication was not established until 1866, the first Atlantic cable was laid, as will be remembered, in 1858, but after working slowly and imperfectly for about three weeks, notwithstanding the daily cheering announcements of "All right. De Sauty," communication ceased; and eight years elapsed before its more reliable successor completed and established the work which, under such difficulties and discouragements, had been prosecuted to final success.

We have received a copy of the Journal of "The Telegraph Electrical Society" of Melbourne (February to April, 1876). It contains a brief discussion by the members on the singular manner in which faults occur in telegraph offices.

An effort is being made to secure the laying of a submarine telegraph cable from the western coast of the United States to Asia. A bill favouring such an enterprise passed the United States Senate a short time since, but it has been recalled from the House of Representatives for further consideration. It is stated that, under present arrangements, a message from the Pacific States to China, Japan, or Australia has to travel 25,000 miles in order to reach its destination, with corresponding cost, while if the proposed cable is laid the distance will be reduced to 6000 miles, and the cost of communication will be reduced also at least 60 per cent.

The *Sussex Daily News* thinks the time has now come for a strong appeal in favour of a thorough organisation of the Post Office, which it considers to be growing more ineffective and untrustworthy every week. Even in such a case as the transmission of news about the Balham mystery, the arrangements failed. Special instructions had been given to St. Martin's-le-Grand. The little suburb is so close to London, that it could have cost nothing to ensure prompt transmission. Yet the verdict took the Post Office a whole hour to deliver in London. Meanwhile, the news was anticipated by horse-messengers, and messengers by train, and was known in all the centres of information before it was communicated by the dilatory Department. In fact, a fast walker could have delivered the news on foot as quickly as the Department was able to "flash" it. Another case cited is that of a report of recent gunnery experiments at Shoeburyness, which was handed in at the office there the other evening, two or three minutes after 6 p.m. That unfortunate message was being waited for in York at midnight, and did not arrive till 2 a.m., when, of course, it was useless, as the newspaper was by that time made up and gone to press. You hand in a message at noon, and it reaches your correspondent at some unreasonable hour after the delivery of a second telegram which was sent off an hour later. This is constantly the case in Hull, where the Exchange, waiting for its stock-quotations, has the satisfaction of receiving its one p.m. quotations before the report sent from London at twelve o'clock.

A little reprint, entitled "Science at Home," by Walter B. Woodbury, may be commended to amateur experimenters and others, as describing a number of pretty experiments in chemistry, optics, electricity, magnetism, &c., adapted for the magic lantern.—The "Sciopticon" introduced into this country by Mr. Woodbury, a few years ago, appears to supply the want of an instrument which should take a medium place between the old-fashioned, clumsy oil magic-lantern, and the troublesome and expensive oxy-hydrogen lanterns. Some important improvements have lately been introduced into it; *e.g.*, the back glass is replaced by a sheet of mica, and it is proposed to use M. Bastie's toughened glass for the front one. The part also forming the division between the two chambers is now made removable, so that jets for the lime-light may be introduced when desirable.

We understand that a new agency, under the name of the "Oriental and American Telegram Company, Limited," having purchased from the liquidators of the late Oriental Telegram Agency its Registers, Codes, &c., is now carrying on business in Leadenhall-street, under the management of Mr. Otto Rochs.

The s.s. *Dacia* (of the India-Rubber, Gutta-Percha, and Telegraph Works Company), having on board submarine cables to connect Caldera with Valparaiso, in Chili, reached the latter port on the 13th ult.; all well.—The Report of the above Company states that the last half-year's trading at Silvertown and Persan has left a profit of £13,500. The returns of the general business of the Company, apart from cable sales, have, within £500, maintained the improvement attained last year, on the returns of the two previous years; and this, in view of business depression, is thought satisfactory. The transfer of the South American cables to the West Coast of America Telegraph Company has been completed, but any profit arising therefrom will be dealt with at the end of the year.

At the half-yearly meeting of the proprietors of the Submarine Telegraph Company, on 15th ult., the report stated that the accounts, compared with those of the corresponding period of 1875, showed an increase in the receipts. of £2,786 during the six months ended 30th June. A dividend at the rate of 16½ per cent. per annum was declared, and £2,366 added to the reserve fund.

The traffic receipts of the Western and Brazilian Telegraph Company (Limited) for July were £7,305, against £9,040 for the corresponding month of last year. The Pernambuco-Bahia section was interrupted from the 1st to the 15th, and the Bahia-Rio de Janeiro section since the 18th July.

The Eastern Telegraph Company invite applications for the unallotted portion of £700,000 Six per Cent. Preference shares £10 each, of which, it is stated, that a large part has been already taken up by the ordinary shareholders. The money is required to duplicate the Red Sea and Bombay-Suez sections. The same Company announce that the average time of transmission of messages in July was:—From Calcutta to London, 39 minutes; and from Bombay to London, 29 minutes.

The traffic receipts of the Direct United States Cable Company, Limited, at 3s. per word, for week ending 12th August, 1876, were £2,600; 19th August, £2,950; 28th August, £2,850.

Electrical Science in Foreign Journals.

COMPTES RENDUS OF PARIS ACADEMY.

NO. 5: 31ST JULY, 1876.

Fifth Note on Electric Transmissions through the Ground. By M. DU MONCEL.—Reserved.

On Globular Lightning. By M. PLANTÉ.

SEVERAL cases of this, in Paris, on 24th July, are recorded. M. Planté thinks it results—1. From aggregation, in spherical form, of ponderable matter, especially air and steam, through suction and rarefaction caused by the electric fluid in its passage. 2. From condensation of the positive electricity in this envelope or medium of rarefied matter, electricity which is dissipated without noise, if the ground is strongly negative by influence of the electrified cloud, or which causes an explosion when the electricity of the fulminating globe can combine with the opposite electricity of the ground.

NO. 6: 7TH AUGUST.

Process for Determining Hydro-carbons, and especially Fire-damp in Mines. By M. COQUILLION.

HE makes a certain number of mixtures of air and proto-carburetted hydrogen, introduces a given volume of the mixture into a tube closed at one of its ends, and in the middle of which is soldered a palladium spiral. He reddens the spiral with a current, awaits cooling, and then measures the remaining gas. Precautions are taken to have comparable experiments, so that he can estimate the quantity of fire-damp contained in a given atmosphere. (Platinum wire with mixtures of carburetted hydrogen and air gives frequent detonations, but palladium wire gives none.)

Note on the Annual Revision of the Magnetic Map of France. By MM. MARIÉ-DAVY and DESCROIX.

THIS first note gives M. Descroix's observations on declination at thirteen different places. From June, 1875, to June, 1876, the mean annual variation at Paris was—0′ 2 12″.

NO. 7: 14TH AUGUST.

No papers on electrical subjects.

MONATSBERICHT OF BERLIN ACADEMY.

JANUARY, 1876.

No papers on electrical subjects.

FEBRUARY.

On the Relation of Electric Conductivity of Selenium to Heat and Light. By DR. SIEMENS.

AN important paper, describing continued researches on the subject. Crystalline selenium, in relation to heat and electricity, behaves differently from other simple bodies. With tellurium and carbon it has the abnormal property of conducting electricity better at higher temperatures. But it loses this property on being slowly heated to 200°, behaving then like a metal, *i.e.*, its conductivity increases with cooling. This metallic state, however, of the amorphous selenium, which has passed into the crystalline condition at the higher temperature, is not stable, but, in and after cooling, the substance forms slowly again into the selenium conducting not metallically but electrolytically, becoming crystalline at a lower temperature, with a dissolved residuum the quantity of which depends on the temperature to which the cooling has occurred. Selenium is a simple body; it cannot be peculiar chemical combinations or transformations that cause these different states; and it is probable that there is a third allotropic state assumed by solid selenium on slow heating to 200°C, a state which is only stable at this temperature, and at lower temperatures is only saved from complete destruction and transformation into electrolytically-conducting selenium, by being dissolved in this or combined with it. Thus may be explained the fact of a turning point at which the metallic conduction passes into electrolytic conduction, as also the lowering of this with time and fall of temperature. It is the most characteristic mark of a metal that its resistance to conduction increases both with the temperature, and with the latent heat which it takes up. Thus selenium may be considered a metal after slow heating to 200°C. The transformation must be sought in a yielding up of latent heat; and we must therefore suppose that selenium in the crystalline as well as in the amorphous state is an allotropic modification of the metallic selenium (*i.e.*, that which is free of latent heat), and that it is distinct from other metals, in that these only take up latent heat with a change of aggregate state, whereas it takes up latent heat also at all temperatures under 200°C. The idea is readily suggested that tellurium and carbon behave similarly. Perhaps further researches may show that also all simple non-conducting bodies are allotropic conditions of their simple radicals (in their case incapable of existence), *i.e.*, that in the solid state they contain latent heat, and for this reason are non-conductors of electricity, like amorphous selenium.

MARCH.

Experiments on the Electro-magnetic Action of Electric Convection. By M. ROWLAND.—See p. 207.

Report on Experiments of Dr. Root on the Penetration of Platina with Electrolytic Gases. By M. HELMHOLTZ.

HELMHOLTZ supposed that in galvanic polarisation, not merely the gas adhering superficially to the platina electrodes, but also that which penetrated into the metal, took part. Dr. Root proved this experimentally. On the two opposite sides of a vertical platinum sheet, 0·02mm. thick, were attached with shellac two glass-vessels, like tubulated retorts; one opening of each being closed by the platinum, the other being directed upwards. Acidulated water was put in the vessels, and in each another platina plate, which, like the middle one, had been carefully annealed and cleaned. The whole was put under the receiver of an air-pump, the conducting wires only of the three plates projecting. The point was to note whether the hydrogen brought to one side of the middle plate by electrolysis would become perceptible on the opposite side, by causing galvanic polarisation there. It was so. All three plates having first been joined to earth for eighteen hours (to remove any previous polarisation), and being carefully tested for other possible causes of polarisation, the outer plate A and the middle one B were then connected with two Daniell elements, so that hydrogen was transferred to B, and in only five minutes there appeared a change in the electromotive behaviour of B relatively to the second plate C. When the current between A and B was reversed, so that oxygen was forced towards B, the result on the other side of B occurred as quickly and often with more intensity. If the plates B and C were a short time connected, after B was charged with gas from A, then immediately after breaking the connection, the difference of potential between the two was *nil;* but it then rose again on the same side as before connecting. This re-appearance of polarisation M. Helmholtz explains by supposing that the depolarising current removes the gases only from the surface layer of platinum, and thereafter new supplies of gas press forward to the surface.

APRIL.

On the Neutral Combs of the Holtz Machine. By M. RIESS.

THIS name he gives to the two combs that have been affixed in addition to the original two of the Holtz machine. They increase the length of spark, and prevent the electrodes changing their species of electricity. One convenient form of them for the simple machine is that of a closed brass pipe, with two comb-ends, and pivoted at the middle. It is placed with a certain inclination to the horizon. The action of these neutral combs M. Riess explains to be this:—They hinder an electrical disc, which has by influence excited the one paper-armature of an electrophorus machine from going to the second armature with its whole quantity of electricity, and electrifying it more strongly than the first one. In Poggendorff's double machines, the central combs are indispensable; but with the simple machines it is better in some experiments to do without them (*e.g.*, in charging of large batteries), the end being then more quickly reached.

JOURNAL TÉLÉGRAPHIQUE.

NO. 19: 25TH JULY.

General Considerations on Telegraphic Tariffs (continued).

THE writer re-affirms the results of Belgian experience six years ago, one being that reduction of telegraphic tariff causes a diminution of net product, under the most advantageous conditions known. Again, he thinks there is no immediate or absolute necessity that a telegraphic service be self-supporting, that is, that it cover all its expenses by means of taxes paid voluntarily by those who use it. To the question, "Is it desirable that the product of the taxes exceed the expenditure, and procure a permanent profit?" he gives an affirmative answer, with two reservations—1. Provided the taxes producing this profit be not of a nature to avert the development of correspondence. 2. Provided that, in the case of private enterprises, the control of the Governments limit the profit to what is useful and legitimate to cover the risks, the surplus being restored to the public in the form of ameliorations of the service or reductions of the tariff.

Complement of Comparative Statistics of 1874.

Automatic Printing-Apparatus of M. Olsen (continued).

Reviews.

Exposé des Applications De L'Electricité. Par LE COMTE TH. DU MONCEL, &c., &c. Troisième Edition, entièrement refondue. Tome Troisième, 1874; Tome Quatrième, 1876. Paris: Lacroix. Prix, 12f. 50c. chaque volume.

(Concluded from page 228.)

THE fourth volume, to which we must now briefly refer, is devoted to the various mechanical applications of electricity to science, industry, and art. The first section of the three into which this volume is divided is occupied entirely to electric clocks and the like; and here again the fertility of electrical invention is strikingly shown. One is tempted to ask at first sight, as M. du Moncel remarks, what advantage can there be in introducing into the simple mechanism of a clock an agent so costly and capricious as electricity? But it is evident the great value of electricity as applied to horology arises from the fact of the practically instantaneous transmission of a current whereby the synchronism of various clocks can be secured and governed from one standard regulator.

Another use of electricity is the employment of it as a prime mover in clocks; and thus, by lessening the number of wheels and obviating the necessity of winding, it reduces the attention a clock requires. As yet, this object has only been partially successful, and at best is less important than the distribution of correct time, which is at present the chief value of electric clocks. It is not too much to expect that within the next ten years all the chief towns in our country will have a system of electric-clocks daily controlled from Greenwich; so that the existing local irregularities of time will become unknown.

The most perfect form of electric-regulator is undoubtedly one in which the fluctuations of strength in the current shall not affect the rate of the clock. This is best accomplished by a form of *remontoir* escapement, an electro-magnet lifting a small weight or less preferably bending a feeble spring that is left free to act upon the fall of the pendulum. So far as we can ascertain, the first clock of this kind was invented by Mr. Shepherd, and exhibited at the Great Exhibition in 1851, a paper on this invention having been read before the Society of Arts, in the early part of that year, by the inventor; this clock is fully described in Tomlinson's excellent "Cyclopædia of the Useful Arts," article "Horology." One of the few omissions we have been able to discover in M. du Moncel's work is the absence of all mention of this clock; Froment's pendulum, which is almost the same as Shepherd's, was invented in 1855, and is described by Du Moncel. Quite recently other inventors have hit upon the same idea, and published their discovery in the belief it was new. We are still more surprised at the omission of Ritchie's name from this volume; the system of electric control-clocks, manufactured by Mr. Ritchie, of Edinburgh, is largely used throughout England—almost exclusively, we believe, in Dublin—and some description of them should have been given. Nor have we met with a description of an electric control-clock employed in some of the continental observatories, where the oscillation of the pendulum interrupts the circuit by a disc of mica cutting a slender thread of mercury, which immediately afterwards reunites by capillary attraction.

Many ingenious contrivances, in which Electricity plays a prominent part, are described in this volume. Thus, we find a clever arrangement devised by the author, which at the proper time recalls one's attention to various engagements that may have been made for any or every day in the month.

The second section of this volume is devoted to electric registration; in it we find the most complete account of the various chronoscopes and chronographs with which we are acquainted. The admirable arrangements employed by M. Cornu, in determining the velocity of light, is here described in full. The employment of the spark of an induction coil, to produce a mark on a revolving drum, was first suggested by Siemens, and has been lately employed by Professor G. C. Foster, in conjunction with the vibration of a tuning-fork, after the manner suggested some years ago by Schultz and Lissajous, whose chronoscope is fully described here.

Following the chapter on chronoscopes, we come to the various methods adopted for meteorological registration. The form of anemograph, invented by Mr. Gordon and made by Mr. Apps, ought to have found a place in this chapter, which otherwise appears to embrace everything of importance in this direction. The simple and excellent method of electric registration of wind and rain, invented by Mr. Yeates, of Dublin, and first described in this JOURNAL, is here taken from our columns. This section concludes with a brief chapter on the miscellaneous application of electricity for the purpose of physiological or artistic registration.

The third and last section is occupied with the application of electricity to the prevention of railway accidents, and the various means of communication between passengers and the guard or driver of the train. This subject seems treated in the same exhaustive and excellent manner that characterises the whole work.

In conclusion, we can only repeat the very high opinion we have already expressed of the value of this truly herculean and excellent work. We ought to add that the text is fully illustrated by woodcuts, and numerous excellent plates are appended to each volume.

W. F. Barrett.

Handbook of Electrical Diagrams and Connections.
By Charles H. Davis, and Frank B. Rae.
New York: The Graphic Company, 1876.

This work (the title of which seems open to some criticism) illustrates in elegant and convenient form the various telegraph systems now in use, and will doubtless prove acceptable in this country (as in America), as supplying a special want. The authors begin promptly with a description of the key, relay, sounder, and register, and some of the principal batteries used; (this part might perhaps be made a little more comprehensive.) The plates, thirty in number, illustrate a simple Morse terminal station, various forms of repeater, the different systems of duplex working, submarine cable apparatus and manner of working, the automatic system, Edison's electro-motograph, the quadruplex, &c. These diagrams are distinct and well executed, and the eye is often relieved among dry details of wire, magnet, and battery, by pleasing additions of an ornamental order. The descriptions accompanying the plates are mostly clear and good. We notice, however, a certain slovenliness here and there in the printing—*e.g.*, "heighth" (p. 20), "Siemans" (p. 21), "principal" for "principle" (p. 37), "eletricity" (p. 39). The common mistake is made of spelling Sir William Thomson's name with a "p." The style also, might occasionally be improved, as where it is stated (p. 38) that "only a sufficient portion of the main current is leaked off as will serve to charge the electro-magnets." There is at the end a useful "Paragraph History of Electricity and Telegraphy," but it requires careful revision, especially in its proper names. Ruhmkorff's "magneto-electro introduction coil" is a decided novelty to us!

PATENTS.

(12th August to end of September 1875.)

2844. Sir James Anderson, E. Bull, and G. O. Spratt.—"Improvements in electric telegraph apparatus."—12th August, 1875.

2919. A. Billet.—"An improved automatical apparatus, applicable to electric telegraphs for regulating their working."—19th August.

2921. J. H. Johnson.—"Improvements in electric clocks or clockwork."—19th August. (A communication.

2934. G. B. Dixwell.—"New and useful improvements in steam-engines."—20th August. (This includes an electrical alarm apparatus.)

2946. C. A. Favre.—"Improvements in thermo-electric batteries and electrometers."—21st August.

2996. W. J. Kilner.—"Producing a continuous current of electricity by means of a rotating magnet or magnets, in combination with or without an apparatus for regulating the tension of the current."—26th August.

3002. J. Bullough and J. Smalley.—"Improvements in stopping motions, applicable to machinery for preparing cotton and yarn and other fibrous substances."—26th August.

3032. F. Wilkinson.—"Improvements in stop motions for machines for slubbing, roving, and weaving cotton-wool and other fibrous materials."—28th August.

3048. L. Gosling, and L. Gluckstein.—"Improvements in apparatus for lighting gaseliers or street lamps."—31st August.

3085. T. Richardson and A. Moffat.—"Improvements in the means of communication from passengers to guards and drivers of trains, and in apparatus employed therefor."—2nd September.

3096. J. Bandot—"Improved electric telegraph apparatus."—3rd September.

3131. G. White.—"Improved mechanism for warning the engine-driver, in the event of any of the carriages becoming separated from the engine, and for inter-communication between the passengers, guards, and engine-drivers."—7th September.

3187. J. Rogers.—"A new or improved galvanic shield or protector, for imparting electricity to the chest or lungs, and other parts of the human body."—11th September.

3243. E. Alexander.—"Improvements in magnets, electric machines, and in electro-motive engines."—16th September. (A communication).

3335. W. Gilbee.—"Improvements in and apparatus for signalling on railways."—24th September. (A communication).

3336. E. Jones.—"Improved means for utilising certain material produced in the process of galvanising iron."—24th September.

3340. J. and G. Fuller.—"A new or improved galvanic battery, applicable to telegraphic and other purposes."—24th September.

3341. E. Vaughan.—"An improved alarm-apparatus, for steam and other pressure gauges."—24th September. (A communication.)

3345. H. G. Gothwicke.—"Improvements in medical appliances, for the cure or relief of nervous and other diseases."—24th September.

3354. F. Rooke.—"Improvements in intensifying coils and contact breakers for electric circuits."—25th September.

3364. W. Lake.—"Improvements in magneto-electric machines."—25th September. (A communication.)

3374. J. Muirhead.—"Improvements in electric telegraphs."—27th September.

3382. W. P. Lyon—"Improvements in the means or method of applying magnetism for curative and other purposes."—28th September.

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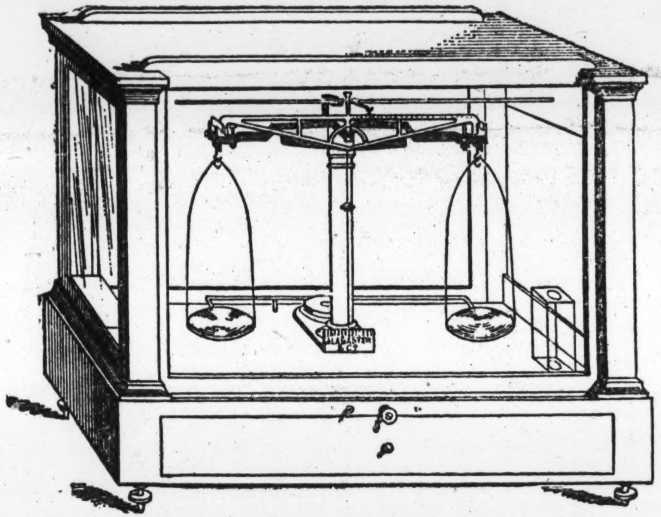

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